Some Observations on Mr. Brande's *Paper on Calculi. By* Everard Home, *Esq. F.R.S.* Read May 19, 1808. [*Phil. Trans.* 1808, *p.* 244.]

In consequence of Mr. Brande's observations, that either acids or alkalies may be attended with injurious consequences, Mr. Home adduces various cases, for the purpose of doing away the expectation generally entertained, of relief from the use of solvents.

The first case is that of a person who had been relieved of the symptoms of calculus while taking saline draughts in the state of effervescence, but in whose bladder were found, after death, as many as twenty calculi; but the prostate gland had become enlarged, and had formed a barrier, so as to prevent the neck of the bladder from being irritated by them.

The second patient had used Perry's lixivium, with the same apparent benefit, which, in fact, arose from the same cause as the preceding.

Mr. Home has also found calculi in cysts, between the fasciculi of the muscular coat of the bladder, even so many as three or four in the same bladder, in which cases the usual symptoms of stone would not occur.

A gentleman having, at the age of seventy, voided a small uric calculus during a course of alkaline medicines, continued to use them at intervals for four or five years, suffering occasionally in a slight degree, but passing no more calculi. After his death about 350 light spongy calculi, consisting of the phosphates cemented by uric acid, were found in his bladder, which, in Mr. Home's estimation, were occasioned by the use of alkalies, in the manner suggested by Mr. Brande.

Another gentleman, who was found, by sounding, to have a stone in his bladder, took fossil alkali for about three months, after which he underwent the operation of lithotomy. The stone was found, externally, composed of pure triple phosphate of magnesia, in spiculated crystals, while the central parts had also a mixture of uric acid with the phosphates, so that the alkali had prevented the formation of uric acid; but the deposition of the phosphates appeared to Mr. Home more rapid than before.

On the Changes produced in Atmospheric Air, and Oxygen Gas, by Respiration. By W. Allen, *Esq. F.R.S. and* W. H. Pepys, *Esq. F.R.S.* Read June 16, 1808. [*Phil. Trans.* 1808, *p.* 249.]

The importance of a process so essential to life having excited proportional curiosity in philosophers from the earliest ages, the authors of the present communication take occasion to trace the history of their subject. Beginning with the conjectures of Hippocrates and of Plato, they proceed to notice the first accurate notions of Boyle and of Mayow, which were neglected and forgotten till the time when Priestley and Scheele first distinguished the two constituent parts of the atmosphere from each other.

The next discovery of importance on respiration, is that by Dr. Black, who observed the formation of carbonic acid. Succeeding labourers in the same field of inquiry, it is observed, are too numerous for justice to be done to every one; and the principal information collected from them relates to measures of quantity. Dr. Goodwin estimated the residual gas in the lungs, after expiration, at 109 inches. Dr. Menzies found the absorption of oxygen nearly 52,000 inches in twenty-four hours.

Lavoisier and Seguin, from a series of elaborate experiments, concluded that more oxygen was absorbed than evolved, as carbonic acid, and thence imagined that water was formed by the union of oxygen and hydrogen in the lungs.

Their experiments showed the consumption of oxygen to be greater in a colder atmosphere, and to be increased also during digestion and during exercise; and they estimated the average consumption at 41,000 inches per day.

The quantity of carbonic acid formed, was first estimated by Mr. Davy.

The authors conceiving that many important points are not yet satisfactorily settled, undertake to examine in the present communication,—

1. The average quantity of oxygen converted into carbonic acid in ordinary respiration.
2. Whether oxygen is absorbed by the blood.
3. Whether azote is absorbed, and whether hydrogen or other gas is evolved.

On account of the impossibility of knowing, with precision, the quantity of gas remaining in the lungs after expiration, and the consequent difficulty of deciding whether any gas is absorbed in the act of respiration, it was determined to perform the experiments on such large quantities of air at a time, that the error arising from residual gas might bear a small proportion to the whole quantity.

The apparatus for the first five experiments consisted of two gasometers, one of which contained 4200 inches of atmospheric air over water, from which the inspirations were made, and the other being filled with mercury, was employed to receive the gas after expiration; but as its capacity was only 300 inches, it was necessary for the operator to retain his breath for about fifteen or twenty seconds, till the quantity expired had been read off, noted, and expelled from the gasometer; after which the same process was repeated about twelve times. The quantity of inspired air having now been read off from the water gasometer, the quantity expired was ascertained by casting up the amount of the successive fillings of the mercurial gasometer. From an average of these five experiments, there appeared to be a diminution of twenty inches in 3700. But the authors are inclined to ascribe this difference to the difficulty above mentioned, of bringing the lungs to the same state of contraction after the experiment as they had been before.

In determining the *quality* of the expired gas, lime-water was first

employed for the absorption of carbonic acid, and then a solution of green sulphate of iron, saturated with nitrous gas, to determine the quantity of oxygen that remained.

In the sixth experiment there were found 9 carbonic acid, and 9 oxygen; together 18.

In the seventh experiment there were found 8 carbonic acid, $10\frac{1}{2}$ oxygen; together $18\frac{1}{2}$.

In the eighth experiment there were found $6\frac{1}{2}$ carbonic acid, and $12\frac{1}{2}$ oxygen; together 19.

In the ninth experiment there were found 7 carbonic acid, and 11 oxygen; together 18.

So that as one measure of carbonic acid contains just an equal measure of oxygen, the apparent diminution of oxygen in these experiments is $2\frac{1}{2}$ per cent.

In the subsequent experiments two mercurial gasometers were employed, so that the hurry of measuring the gas, and inconvenience of retaining the breath, were avoided, and the respiration was consequently more natural throughout the whole of each experiment.

Nevertheless, the result of the ten experiments still showed an apparent diminution of 1 per cent. But the eleventh experiment showed no diminution, and is considered by the authors as a standard experiment. From this the quantity of oxygen consumed, and of carbonic acid formed in a minute, is calculated to be $26\frac{1}{2}$ inches, and hence the quantity of solid carbon given off by the lungs, in twenty-four hours, is computed at $10\frac{3}{4}$ ounces troy.

The person who made these experiments breathes about nineteen times in a minute, and takes about $16\frac{1}{2}$ cubic inches of air at each natural inspiration.

In the twelfth experiment the same quantity of air was breathed from one of the mercurial gasometers to the other repeatedly during three minutes, and was then found to contain $9\frac{1}{2}$ carbonic acid, $5\frac{1}{2}$ oxygen, and 85 azote per cent.; so that six parts, in 100 of oxygen, seemed to have disappeared, and some other gas, not absorbed by water, was apparently given off from the lungs.

The results of the fourteenth experiment were similar, and more remarkable, as the respiration of the same air was continued for a greater length of time: 100 parts contained 10 carbonic acid, 4 oxygen, and 86 azote; so that in this instance there appeared a loss of 7 oxygen, and an equal increase of azote, or of some other gas not absorbable by water. By careful examination, the authors are satisfied that no other gas is present in the residuum but azote; that the azote itself, though apparently in greater proportion, is in fact unaltered; and that the difference arises solely from diminution of oxygen when respiration is painfully protracted.

By the respiration of another person, whose chest was of greater capacity, the same quantity of air as by the former was taken in just one half the time; but nevertheless very nearly the same proportion of it was found converted into carbonic acid.

In the succeeding experiment nearly 10,000 cubic inches of air

were breathed. The quantity of carbonic acid was in this case 8, the remaining oxygen 13, and the azote 79 per cent., as before inspiration. The average consumption of oxygen, and formation of carbonic acid, being 32·3 inches in a minute.

The deficiency in the quantity expired was so small, that the authors were satisfied that none was absorbed. But in the two following experiments, which were each performed on upwards of 3000 inches of *oxygen* gas, the deficiency was much greater, and there *did* appear to have been absorption of 58 in one experiment, and of 67 in the other.

The formation of carbonic acid was, in these cases, far more rapid, being at the rate of $37\frac{1}{2}$ inches in a minute. From the quantity of air which had necessarily remained in the lungs before the experiments, a quantity of azote was unavoidably mixed with the inspired oxygen, and emitted with it, in the proportion at first of 25 per cent., but varying in the successive portions, removed for trial, till the proportion was at last reduced to $5\frac{1}{2}$ per cent.

From these data, the authors endeavour to estimate the quantity of air that had been in the lungs at the beginning of each experiment.

By estimation from the former experiment on oxygen, the residue in the lungs appeared to have been $140\frac{1}{2}$; but in the second, it was found that as much as 177 of mere azote had been expired, and hence that the lungs, in this instance, had contained as much as 226 inches of air, unless the proportion of azote in the residual gas was greater than usual, in consequence of previous fatigue.

The inferences drawn by the authors from these experiments are,

1. That the quantity of carbonic acid emitted is equal in bulk to the oxygen consumed, and consequently that no water is formed in respiration by union of oxygen and hydrogen.
2. That carbonic acid, in expired air, varies from 8 to 10 per cent.
3. That about 1800 inches of carbonic acid are formed in twenty-four hours, containing about $10\frac{3}{4}$ ounces troy of solid carbon.
4. That when air is breathed several times over, a portion of oxygen is absorbed.
5. More carbonic acid is formed from respiration of oxygen, than in breathing atmospheric air.
6. That the subject of these experiments takes about 17 inches at each inspiration, and makes about 19 inspirations in a minute.
7. No hydrogen or other gas appears to be evolved during respiration.
8. There appears to be no alteration in the quantity of azote, since the average diminution of six parts in 1000 is more likely to arise from incomplete exhaustion of the lungs after the experiment.
9. The residual gas in the lungs, after forced expiration, appears about 140 cubic inches.